ADDRESS OF THE PRESIDENT,

Dr. H. Woodward, F.R.S.

Delivered July 13th, 1894.

The saying of Harvey, the eminent physician and the discoverer of the circulation of the blood, "that every living thing is produced from an egg" (*omne vivum ex ovo*), uttered nearly 250 years ago, contains a great and fundamental truth, which is still valid, although it may not be of such universal application throughout nature as Harvey believed it to be.

Certain it is, however, that on the 27th of February, 1893, in an upper chamber in Chancery Lane, there was hatched, *ex ovo*, under the auspices of my friend Mr. Wilfrid H. Hudleston, F.R.S., assisted by Mr. E. R. Sykes, Mr. E. A. Smith, Mr. B. B. Woodward, Mr. G. F. Harris, and several other naturalists, a promising infant, which was at once christened the "Malacological Society of London."

The object for which our Society has been founded, namely, the study of the Mollusca and Brachiopoda, is one with which the name of my brother, the late Dr. S. P. Woodward, will always be associated; and I cannot but feel that in selecting me as your first President, I am in a sense benefiting by relationship, and was not wholly chosen from personal fitness for the position. In any case I should be guilty of a breach of duty if I omitted to thank you on this occasion for the great honour you have conferred upon me.

It is with no small degree of satisfaction that we, who were present at the birth of our infant Society, have watched its growth from month to month, during this early period of its existence, and have seen the steady increase of its members up to the present time; and, although only a year and five months have elapsed since its foundation, we may justly feel proud of the quality and number of the papers that have already been presented for reading and publication.

Inaugurated on 27th February, 1893, with 70 original members, our Society numbered in June, 1894, 153 Members. Of these, 102 are British, and 51 Corresponding Members, who reside abroad. To these latter Europe contributes 17 members; South Africa 5; Australia, Tasmania, and New Zealand 19; North America and the West Indies 7; China, the Philippines, and the Sandwich Islands 3. Thus, whilst the Imperial Institute, with its large resources, is still only on the threshold of Imperial Federation, the Malacological Society, with its extremely slender means, may be said to have solved the far wider question of the Federation of the whole World.

Only three parts of the "Proceedings" have been issued, but we may refer to these with satisfaction, as giving an earnest of good things to come, both as regards anatomical papers and also those devoted to descriptions of recent and fossil shells.

Although our Income is a very modest one, it has been found sufficient for our needs, and the Society has not only been able to pay its way but has also a credit balance with its Bankers to defray future expenses of printing and publication; so that financially we are standing upon a firm basis.

Another subject of congratulation lies in the fact that we incur no expense for rent of premises. Thanks to the kindness of the President and Council of the Linnæan Society, we are now permitted to hold our monthly meetings in that Society's apartments at Burlington House, a privilege for which we cannot but be extremely grateful, not only as contributing to the comfort and convenience of members, but also as affording a place of meeting of the very best kind that could be obtained in London.

We have now, however, said sufficient concerning ourselves, save to deplore the loss which we have sustained by the death of one, probably the most eminent, of our Corresponding Members. I allude to the decease of Dr. Paul Fischer, of Paris. This eminent Malacologist, who died on the 29th November, 1893, took from the first a lively interest in our Society, and, had he lived, it was his intention to have contributed papers to our "Proceedings."

Born 7th July, 1835, Paul Fischer was for many years Assistant-Naturalist to the Chair of Palæontology in the Museum d'Histoire Naturelle at Paris. He was evidently not an ambitious man, for he does not appear to have sought any higher post, although his wide scientific knowledge in every way qualified him for such.

He was a prominent member of the Commission on Submarine Dredging, and also of several scientific Societies; but it is from his published works that we know most about him. Dr. Fischer was a prolific writer, being author of upwards of 300 Memoirs, and joint-author with his co-Editor of the "Journal de Conchyliologie" (M. Crosse) and with MM. Delesse, Tournouër, Bernardi, and others, of about 100 additional papers.

Dr. Fischer wrote upon many branches of Zoology; such as the Brachiopoda, the Bryozoa, the Hydrozoa, and the Porifera; nor were the Vertebrata entirely neglected. Geology also interested him to a certain extent, if we may judge from his "Observations on the Lower Tertiary beds of Madagascar" and on the geology of the southern part of that island; but it is principally by his researches in the domain of Malacology that he is best known to the scientific world.

After contributing a series of articles to the Journal de Conchyliologie (1856–57) on the anatomy of little known Molluscs, we find him dealing with the respiratory organs of the Pulmonata; the general structure of *Xanthomya* and *Hyalimax*; the anatomy of the genus *Septifer* and of the American *Cyrenæ*; whilst his other papers on kindred subjects are far too numerous to be referred to here separately. Amongst his larger works we may mention his joint memoir with M. Crosse on the Mollusca collected by the Scientific Mission to Mexico and Central America; also with M. Tournouër, on the invertebrate fossils of Mont Léberon in Vaucluse; and the Mollusca collected during the voyage of "La Travailleur" and the "Talisman."

Although the production of such a large amount of good work would amply suffice to stamp its author as a Malacologist of the first rank, yet Dr. Fischer's highest claim to our attention is the publication of his *chef d'œuvre*, the "Manuel de Conchyliologie" (1880–87). Struck by the method of arrangement and general excellence of Dr. S. P. Woodward's "Manual of the Mollusca" (1851–56), Fischer at first essayed to bring out a new and revised French edition of that work, rendered necessary through the lapse of time and the progress of discovery since its first publication; but he found the task involved practically the re-writing of the whole, the ultimate result being the production of the great work we have alluded to. It is easy to see, by an examination of the Manual, that its author was anxious to perpetuate the memory of Dr. S. P. Woodward, of whom he was a most earnest and ardent disciple. He not only reproduced the greater part of the text of Woodward's "Manual," but also his map of the provinces and all his figures. Since imitation is said to be the "sincerest form of flattery," English Malacologists have every reason to be proud of Dr. Paul Fischer's tribute to the memory of Dr. S. P. Woodward.

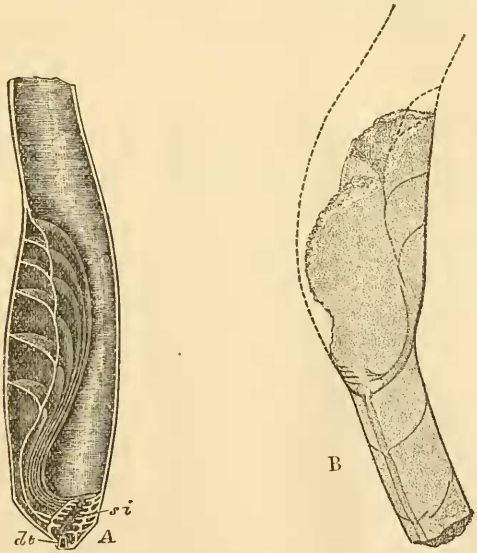
Turning for a moment to the Institution to which I have the honour to belong, let me draw attention to one of the many interesting features of our British Museum of Natural History in Cromwell Road, viz. the commencement in Bay No. 7 of the Central Hall, or "Index Museum," of a most instructive object text-book of Malacology, prepared, at the request of Sir William Flower, the Director, by our Editor, Mr. B. B. Woodward, in which, by the judicious selection of some of the specimens and the preparation by marking or cutting of others, and aided also by excellent descriptive labels, the student may read, as in the open pages of a finely-illustrated book, "the story of the shell."

There is an interesting series to show the forms of hinge in the Bivalve Mollusca, giving all the gradations from shells like *Megalodon*, *Cyrena*, *Trigonia*, and *Cyprina*, with complex, powerful, and well-developed hinge-teeth, to forms like *Lutraria*, *Mya*, and *Ostrea*, with simple, extremely small, or quite obsolete teeth. The variations in shape of the muscular impressions or scars and the pallial border in the Bivalve shell are displayed in another group of specimens. These are carefully coloured so as to mark out the scars of the anterior and posterior adductor muscles, the pedal muscle, etc.

The variations in external form, within the limits of a single genus of Bivalves, are well illustrated by a series of examples of *Unio* from the rivers of N. America, comprising 34 species selected to show remarkable modifications. I believe Dr. Lea, in America, has described over 300 so-called species of N. American Unios. Yet another series exhibits the variations in a single species of Gastropod, *Paludomus loricatus*, common in the mountain streams of Ceylon, that, on account of its tendency to vary, had been split up into no less than 24 distinct species. The specimens selected as illustrating variation in form, colour, growth, and construction in shells are extremely well chosen and most instructive.

An admirable display of soft preparations in spirits, prepared by Mr. W. G. Ridewood under the superintendence of the Director, or obtained from the Zoological Station at Naples, is also exhibited, comprising Nudibranchs; oceanic forms such as *Carinaria* and *Pteropoda*; and a series of Cephalopoda, some of which have been dissected to show the internal anatomy. We are informed that it is intended to add to this very instructive collection a good series of Radulæ, illustrating, both by figures and specimens, the various forms of the lingual teeth in the Glossophora.

As germane to our special subject I may draw attention to the excellent work carried on now for some years by Messrs. A. H. Foord and G. C. Crick in the preparation of a descriptive Catalogue of the Fossil Cephalopoda in the British Museum (Natural History), of which two volumes have already appeared, whilst one is now in the press. The value and importance of this work will be better understood after an inspection of the interesting gallery in which Mr. Crick's labours are concentrated; a visit to this will well repay the Malacologist. Mr. Crick has endeavoured to carry out in detail, by means of models and illustrations, the structure of the Cephalopod shell. Here, for example, is a figure of a model of his own constructing to illustrate the mode of growth of one of the most curious of camerated shells of Silurian age, the genus *Ascoceras*.



Ascoceras, as modelled by Mr. G. C. Crick, F.G.S.

(A) Diagrammatic Section of Nautiloid portion of shell of *Ascoceras*, showing the structure and arrangement of the septa. *dt.*, duct; *si.*, siphuncle.
(B) Section showing the *Orthoceras* and *Ascoceras* stages united (after Lindström).

I merely draw attention to it in order to show how much may be done by means of the glyptic and graphic methods to illustrate our subject.

Mr. R. Bullen Newton, some time since, prepared an exhaustive list of the British Eocene Mollusca, with especial reference to the remarkable collection formed by the late Mr. Frederick E. Edwards. Mr. Newton found the number of new and undescribed forms in our Eocene beds was far larger than had been estimated, but he hopes in co-operation with our Treasurer, Mr. G. F. Harris, to achieve their gradual description. A beginning has already been made in our "Proceedings," and, if persevered in, it will be the means of rendering our publications of the highest value to workers both in recent and in fossil shells.

Three years ago Messrs. G. F. Harris and H. W. Burrows completed the publication of an extremely useful and valuable memoir on the Eocene and Oligocene beds of the Paris Basin (issued by the Geologists' Association 23rd Sept., 1891, pp. 138). Besides an account of the various localities visited by the authors they give careful lists, with horizons of 3,555 species of Mollusca and an excellent geological map. For some time past these gentlemen have assisted in my Department in naming and arranging the famous Collection of French Tertiary Mollusca formed by M. Deshayes, to which they have also lately added from their own cabinets no fewer than 2,400 desiderated specimens; their labours have now been extended to our Australian Tertiary Mollusca, which rival in beauty those from European localities.

Permit me here to allude to one of the troubles which we older Naturalists have to overcome, namely, the constant kaleidoscopic change of Nomenclature which is taking place in Biology. More especially is this so, when (what Dr. Elliott Coues in America calls) the "splitters" get the better of the "lumpers." This love of change extends, not only to alterations of generic names, which are endless, but also to classes, orders, and families, so that one stands like a traveller who revisits his native city after a long absence, and finds all the old familiar houses removed or rebuilt, and even the names of the streets changed, and the old inhabitants dead and replaced by strangers. These things, however, are the natural outcome of progress and also the result of that youthful energy which impels its possessors, like the Athenians in the days of St. Paul, to spend most of their time in seeing or hearing of some new thing. But Nomenclature, let me urge, is not the sum and substance of our work as Malacologists, important though it be. If we would aspire to rank as priests in the temple which we dedicate to Nature, we should have a real and living knowledge of our subject, not a mere knowledge of its synonymy. Moreover, we must make our subject clear, interesting, attractive, and intelligible to the neophyte, and not chill him with endless verbiage.

Turning now to the history of Thalatology, or the study of the sea and its inhabitants, to which we, as Malacologists, must always attach

the deepest interest, we find that Aristotle had already made researches (B.C. 384–322) on marine animals that were of distinct scientific value. He named and described more or less minutely, in his "Natural History of Animals," 116 species of fishes, about 24 species of Crustaceans and Annelides, and some 40 Molluscs and Radiates, making a total of 180 species inhabiting the Ægean Sea.

Following this great philosopher, but nearly four hundred years later, Pliny the elder (A.D. 23–79), in his "Natural History," presents Aristotle's discoveries modified by much subsequent superstition and tradition. He concisely catalogues marine animals into 176 species, being four less than the number recorded by Aristotle in the Ægean Sea alone. Pleased with this enumeration, he then exclaims: "Surely, then, everyone must allow that it is quite impossible to comprise every species of terrestrial animal in one general view for the information of mankind. And yet, by Hercules! in the sea and in the ocean, vast as it is, there exists nothing that is unknown to us, and, a truly marvellous fact, it is with those things which Nature has concealed in the deep that *we are the best acquainted!*"[1]

How strangely this confidence of Pliny in the knowledge of his time contrasts with Professor Moseley's remark, made almost 1900 years later, that, "by our deep-sea explorations, we obtain, *for the first time, a glimpse* of the fauna and flora of nearly three-fourths of the earth's surface," and "our whole knowledge of the sea-bottom has been created *within a few years*," whilst "before that time we knew little of its fauna and flora beyond what is found on a comparatively narrow belt of the coast-line."

Pliny had to confess himself unable to give a detailed account of the depth of the ocean, some parts of which he stated to be 15 stadia (over 1500 fathoms) deep, others "immensely deep, no bottom having been found"; but he makes up for this in a way by explaining very clearly, "why the sea is salt." He says: "Hence it is that the widely diffused sea is impregnated with the flavour of salt, in consequence of what is sweet and mild being evaporated from it, which the force of the fire [of the sun?] easily accomplishes; while all the more acrid [saline?] and thick matter is left behind, on which account the water of the sea is less salt at some depth than at the surface."

This inquiry as to the saltness of the sea remained a subject of controversy through the Middle Ages and gave rise to a vast amount of unprofitable literature. Kircher, after consulting three and thirty authors upon the subject, could not help remarking that "the fluctuations of the ocean itself were not more various than the opinions of men concerning the origin of the salt in the sea." In 1865 a paper by Professor Forchhammer of Copenhagen, on the Composition of Sea-water in different parts of the Ocean, was published in the "Philosophical Transactions" recording the result of twenty years of patient work, and its publication made an era in the history of

[1] Sir Wyville Thomson's Narrative of the "Challenger."

ocean chemistry. His grand conclusion is that although the salinity of sea-water may and does vary within certain limits, yet if samples be taken in all parts of the open sea, avoiding the vicinity of land and the mouths of large rivers, the proportion of each constituent to the total salts will be found to be the same everywhere. The differences in the surface sea-water, then, are merely differences due to extreme dilution caused by great precipitation, or to concentration caused by great evaporation.

The rage for geographical exploration, which set in after the discovery of America, naturally brought the sea into greater prominence. The story of Sir John Hawkins' experiences, as told by Boyle (1699), is very curious:—

"Were it not for the Moving of the Sea, by the Force of Winds, Tides, and Currents, it would corrupt all the World. The Experience of which I saw *Anno* 1590, lying with a fleet about the Islands of *Azores*, almost Six Months, the greatest Part of the time we were becalmed, with which all the Sea became so replenished with several sorts of Gellies and Forms of Serpents, Adders and Snakes as seem'd Wonderful; some green, some black, some yellow, some white, some of divers Colours, and many of them had Life, and some there were a Yard and a half and some two Yards long; which had I not seen, I could hardly have believed; and hereof are Witnesses all the Company of the Ships, which were then present, so that hardly a Man could draw a Bucket of Water clear of some Corruption."[1]

Sir Wyville Thomson thinks that Boyle's story may have suggested to Coleridge the well known lines in his "Ancient Mariner":—

> "The very deep did rot: O Christ!
> That ever this should be!
> Yea, slimy things did crawl with legs
> Upon the slimy sea."

The history of scientific marine exploration is of no very great antiquity.

Two Italian Naturalists, Marsili and Donati, are said to have been the first to employ the dredge for scientific investigations, about 1750, when with an ordinary oyster-dredge they obtained specimens in shallow water.

In 1779 O. F. Müller, the Danish Zoologist, invented and used a special naturalist's dredge, a net attached to a square iron frame, and with its aid he studied the marine fauna of the shores of Denmark.

In 1805 Péron, a French Naturalist, sailed round the world and made numerous observations on the temperature of the sea. He imagined that the bed of the deep ocean was covered with eternal ice, and that therefore life was impossible in the deep sea.

In 1818 Sir John Ross, during his great Arctic voyage, invented an arrangement, which he called the "Deep-sea Clam," for gripping a portion of the bottom and bringing it up safely, and with it he

[1] Boyle's works epitomized by Boulton, vol. i. p. 281, London, 1699.

succeeded in bringing as much as 6lbs. of mud from the great depth of 1050 fathoms in Baffin's Bay, and from 1000 fathoms in Possession Bay, containing living worms and other organisms. In 1833 Sir John Ross repeated his researches, and frequently dredged in shallow water and down to 70 fathoms, making large collections, which, however, were lost in the "Victory."

Charles Darwin's observations during the Voyage of the "Beagle," 1831–36, were chiefly directed to the bathymetric limit of life in coral-reefs and the structure and origin of coral-reefs generally.

Professor Ball's naturalist's dredge was invented in 1838.

To Prof. Edward Forbes we owe more (in the early days of the past 50 years) than to any other man for the advance of general marine zoology. His definition of zones of life along the borders of the continents and islands, as "Littoral," "Laminarian," and "Coralline" zones and the "Region of the Deep-Sea Corals," have proved of the greatest value to Naturalists and are still current.

Besides acting as Naturalist to H.M.S. "Beacon" in the Mediterranean, where he did such excellent work in the Ægean Sea with the dredge, Professor Edward Forbes accompanied Lieutenant Spratt in the launch "Isabella"; he also dredged with James Smith, of Jordan Hill, with Robert MacAndrew, with William Thompson, R. Patterson, and Robert Ball, all experienced dredgers.

Writing of his cruise in the Ægean Sea, Edward Forbes says: "Whenever it was possible we dredged, and the results are most important. I have found a defined fauna different from any other of the marine zones, between 90 and 200 fathoms in these seas, and with an exact correspondence in its productions over all the examined part of the Ægean—a stretch of 200 miles. I have found starfishes alive in 200 fathoms; *Tellinæ* and *Rissoæ* at 150(!); a bed of chalk full of Foraminifera, and the shells of Pteropoda, forming at the bottom of these seas! Moreover, the most characteristic shells of this hitherto unknown region are species only known to conchologists as fossil." This was penned just 53 years ago.

We must not omit to record the important additions to our knowledge which we owe to the U.S. Exploring Expedition (1838–1842) under Captain Wilkes, in which the great American Naturalist, Prof. Jas. D. Dana, took a leading part.

Sir James Clark Ross in the "Erebus" and "Terror" (1839 to 1843) explored the Antarctic coasts and made important soundings and dredgings in deep water, down to 400 fathoms. The evidence of a low but uniform temperature at great depths in the ocean was established by Ross, and has not since been controverted by later investigators even after 50 years. Ross's collections of specimens of zoology, which were large, were not well attended to, and at his death were found to have been totally destroyed, by want of care in their mode of preservation.

When Sir John Franklin's ill-fated Polar expedition set out in 1845, Mr. Harry Goodsir, a young zoologist of great promise, sailed on board the "Erebus" as assistant surgeon and naturalist. The expedition never returned, and only fragmentary records are preserved

of the valuable work which Goodsir had already accomplished. On the 28th June a dredge was sunk to the then enormous depth of 300 fathoms and brought up many highly interesting forms of living Mollusca, such as *Fusus*, *Turritella*, *Venus*, *Dentalium*, etc.

Captain (afterwards Admiral) Spratt, R.N., did excellent service to marine zoology during his surveying operations in the Ægean Sea (1841–46) and in the Mediterranean also. In 1846 he dredged in 310 fathoms, forty miles to the east of Malta, and found abundance of animal life, including eight species of Mollusca.

In 1850 Michael Sars and his son, G. O. Sars, the Norwegian Naturalists, dredged to a depth of 450 fathoms and found abundance of life, and the descriptions of their collections have been published in a very admirable manner by their Government (Christiania, 1865 and 1869).

Brooke's U.S. Naval Survey of the Coasts of America, 1854, introduced several new methods of accurate deep-sea sounding and dredging. A few years later his sounding-machine was modified and improved by Commander Dayman, of the United States Navy.

In 1857 Mr. R. MacAndrew, F.R.S., in his yacht, the "Naiad," accompanied by my brother, Dr. S. P. Woodward, and by Mr. Lucas Barrett, dredged along the coasts of Spain and Portugal, and made a special examination of the marine fauna of Vigo Bay. Here they obtained besides several new species of *Synapta* many interesting Mollusca, including numerous living examples of *Chrysodomus contrarius*, so abundant as a fossil in our Red Crag of Suffolk. The results of their dredgings were published in the "Proceedings of the Zoological Society" for 1858, and elsewhere.

In 1860 I had the advantage of accompanying Mr. R. MacAndrew on a dredging expedition to Gibraltar and Malaga, where we obtained many interesting forms. Again, in 1863 I accompanied Mr. MacAndrew to Bilbao, Santander, and Coruña, and carried on dredgings with him in Coruña Bay and Ferrol.[1]

The voyage of the "Bulldog" in 1860, under Sir Leopold M'Clintock, is especially noteworthy amongst the cruises of surveying ships. Surgeon-Major Dr. G. C. Wallich, the Naturalist who accompanied the expedition, records that on one occasion a depth of 1260 fathoms was indicated, and that he obtained proof beyond question of the existence of highly organised animal life at these great depths.

During Dr. Otto Torrell's expedition to Spitzbergen, in 1864, a great number of living creatures were taken at a depth of 1000 to 1400 fathoms, in the Maclean nets.

In 1867 Count L. F. de Pourtalès, in the U.S. Coast Survey steamer "Corwen," dredged to a depth of 650 fathoms, on the margin of the Gulf Stream, and the following year in the "Bibb" dredged successfully in the same place in 510 fathoms, finding animal life exceedingly abundant.

In 1868 Sir Wyville Thomson and Dr. Carpenter, dredging from

[1] Ann. and Mag. Nat. Hist. xiv. 1864, pp. 232–5.

the "Lightning," reached the depth of 650 fathoms, and obtained temperature-observations of the greatest interest.

In May, 1869, the "Porcupine," with Dr. Gwyn Jeffreys as scientific director, dredged off the west coast of Ireland. The deepest dredging reached a depth of 1470 fathoms, and no lack of animal life was found. In the September of the same year the "Porcupine" dredged to a depth of 2000 fathoms in the Bay of Biscay, and hauls of specimens from Protozoa to Mollusca were obtained.

In 1869 Mr. Robert MacAndrew, accompanied by Mr. Edward Fielding, proceeded to Suez, and devoted six weeks to dredging along the coast of the Sinaitic peninsula. They obtained 619 species of Mollusca, 355 of which had not been previously recorded from the Red Sea.

In 1870 Captain Marshall Hall devoted his yacht "Norna" to deep-sea dredging work during a cruise along the coasts of Spain and Portugal. In this Mr. Saville Kent and Mr. Edward Fielding took part, and numerous interesting papers were published by the former, based on specimens dredged during the cruise, principally siliceous sponges (as *Pheronema Leidyi*, etc.).

In the same year Dr. Gwyn Jeffreys and Dr. Carpenter made a highly interesting series of soundings and dredgings in the Mediterranean from the "Porcupine," and the following year Dr. Carpenter dredged from the "Shearwater" in the same region.

In December, 1871, and early in 1872 the "Hassler," under the scientific direction of Prof. Louis Agassiz, dredged in considerable depths off the coast of South America.

By far the greatest scientific exploration undertaken by the Government of this country, was that of the Voyage of the "Challenger," with which the names of Sir George Nares, of Sir Wyville Thomson, Buchanan, Moseley, Murray, Willemoes-Sühm, and Wild will always be connected.

The cruise, which extended from 1873–76, was followed by the issue of a succession of volumes from the "Challenger Office" in Edinburgh, lasting from 1880 to 1891, and embracing in some forty ponderous quarto volumes (profusely illustrated) the Narrative, the Meteorology, the Physics and Chemistry, the Botany, and, in thirty-two volumes, the Zoology of the collections obtained during the voyage. It is very agreeable to be able to state that of these volumes, to which so many of our ablest Naturalists have devoted themselves, that on the Brachiopoda (which was the first to appear) was executed by our friend of many years, the late Dr. Thomas Davidson, and appeared in 1880. The Monographs on Mollusca are: *Nudibranchiata*, by R. Bergh (1884); *Lamellibranchiata*, by E. A. Smith (1885); *Scaphopoda* and *Gastropoda*, by the Rev. R. B. Watson (1886); *Marseniidæ*, by R. Bergh (1886); *Polyplacophora*, by Professor Haddon (1886); *Cephalopoda*, by W. E. Hoyle (1886); *Pteropoda*, by Dr. P. Pelseneer (1887–88); *Heteropoda*, by E. A. Smith (1888); Anatomy of Deep-sea Mollusca, by Dr. P. Pelseneer (1888). So that three at least of our Members, namely, Mr. W. E. Hoyle,

Mr. E. A. Smith, and the Rev. R. B. Watson, have taken part in this great work.

Describing the dredging operations, Sir Wyville Thomson writes: "The three most interesting species brought home by the 'Challenger' were *Terebratula Wyvilli*, Davidson; *Terebratulina Wyvilli*, Dav.; and *Discina Atlantica*, King. *Terebratula Wyvilli* was obtained at six different stations, and appears to abound over a wide geographical area, at depths varying from 1035 to 2900 fathoms; the greatest depth whence any living Brachiopod has been brought up."

Of *Terebratulina Wyvilli* (the largest species of the genus hitherto discovered, either recent or fossil) one specimen only was dredged, on the 25th March, 1873, off Culebra Island, to the north-west of St. Thomas's in the West Indies, at a depth of 390 fathoms. *Discina Atlantica* was brought up at six or seven different stations, and is a widely-spread abyssal form.

While dredging and trawling in very deep water off Bermuda, Wyville Thomson mentions taking several species of *Trochus* and other Molluscs in 1075 fathoms, and *Crania* at 435 fathoms.

Of all the Molluscs obtained during the expedition, the most valuable was the unique specimen *Guivillea alabastrina* (alt. $6\frac{3}{4}$ in., diam. 3 in.), a pure white alabaster Volute, of exceptional form, dredged from a depth of 1600 fathoms in the Southern Ocean.

Mr. Edgar Smith, in his General Remarks on the Lamellibranchiata ("Challenger" Reports—Zoology—vol. xiii. part 1, p. 3), is struck by the small number (only about 500 species) obtained, and that they are represented by very few specimens, there being of many of them but a single, or a few odd valves, often badly preserved.

By far the most special interest attaches to the deep-water forms, one of which was obtained from about 2900 fathoms in the mid-North Pacific. This, a small fragile shell, which has been named *Callocardia* (or *Vesicomya*) *Pacifica*, is almost identical with a second species (*C. Atlantica*) dredged from 1000 fathoms off the Azores; and a third species, *C. Adamsii*, obtained S.W. of Sierra Leone from a depth of 2450 fathoms.

Mr. Edgar Smith not only gives a list of species occurring in widely-separated geographical localities, but also in extremely varied bathymetric positions; *Lima multicostata* being found living in 2 and in 1075 fathoms depth; *Pecten vitreus* in 140 and at 700 fathoms; *Area pteroessa* in 390 and 2050 fathoms; *Venus mesodesma* (a shore species) dredged in 1000 fathoms; *Pecten Philippi* and *Dacrydium vitreum* both obtained in less than 40 fathoms, and also from 450 and 1000 fathoms.

A large number of species, Mr. Smith thinks, are equally well adapted for living in deep or in shallow water, and their shells appear to be very little affected by the difference of the depth or the nature of the bottom. Dr. Davidson has also mentioned the same thing in regard to the Brachiopoda; one species (*Terebratula vitrea*) ranging from 5 to 1456 fathoms.

Mr. Edgar Smith points out that the absence of light, however, tends to produce shells without colour, and that the deep shells are

thinner, having a difficulty in secreting lime, whilst food is scarcer in the abyssal regions. He admits that the number of species diminishes in proportion to the depth, thus:—

At depths of 0	to	100 fathoms	9 species	were obtained.
100	to	500 ,,	6·16	do.
500	to	1000 ,,	2·4	do.
1000	to	2900 ,,	2·12	do.

Dr. Davidson makes a similar remark as to the Brachiopoda, that they diminish in number of individuals as well as in species, in proportion to the depth; for out of 125 dredgings in depths of from 1 to 600 fathoms Brachiopoda were brought up 22 times, while in depths varying from 600 to 2900 fathoms they were obtained 16 times.

One is struck by the fact that a shell like *Arca corpulenta* should occur off N.E. Australia in 1400 fathoms; south of Amboyna in 200 to 360 fathoms; mid-Pacific in 2425 fathoms; and near Juan Fernandez in 1375 fathoms; but its relatives are found in shallow water, distributed world-wide, and its ancestors date back to the Lower Silurian rocks; so that it has had ample time for its cosmopolitan distribution.

The Rev. R. Boog Watson's conclusions on the examination of the Scaphopoda and Gastropoda of the "Challenger" deserve to be recorded here:—

1. *Depth*, he says, is an important condition in connection with Molluscan life. That is to say, there really are shallow- and deep-water species and genera, though their bathymetric limits are not constant.

2. *Temperature*, much more than mere depth, seems an important factor in Molluscan life. It is needless to speak here of other conditions, such as the amount of *light*, *food*, or *oxygen*; because, though there are extreme differences in these respects, and though their influence must be very great, still their precise amount and the nature and direction of their effects are too little known to afford foundation for more than guesswork.

Pressure seemed likely to prove a very important condition among those which affect animal life; the enormous pressure upon the square inch which has to be sustained, and the fact that rapid transference from even a moderate depth to the surface, is sufficient to destroy life; but these impressions were removed on recollection of the laws of hydrostatic pressure and the substitution of a gradual for a rapid transference from deep water to the surface.

Temperature, however, remains as an undoubtedly important factor.

3. Great differences in respect of depth and temperature prove barriers to distribution, and so, by preventing the indiscriminate commingling of species, determine and preserve distinct geographical provinces.

4. During the lapse of years accidents are likely to occur, enabling species to evade obstacles which would in ordinary circumstances prove insurmountable. Hence the occurrence of a living species in a fossil

state will always justify the expectation of its having a wide but local distribution, and *vice versâ*.

5. Where barriers of depth and temperature do not check it there seems, in ordinary circumstances, no limit to universality of distribution.

6. There actually are existing species whose distribution is universal, no barriers having availed to stop their passage.

7. There still is no trace, even in these oldest and most widely distributed species, of essential, lasting, and progressive change. I do not wish (says Mr. Watson) to overpress this point, presenting as it does merely negative evidence. I do not assert that there are no species of Mollusca which have thus changed. I only say there are some, even many, of the oldest and most widely distributed species which have not done so, and that, so far as I have had opportunities of observation, no proof has reached me of progressive, permanent, and essential change in Molluscan development.

Without giving details, we may just allude to two Italian expeditions, viz.:—

1. The "Viaggio intorno al globo della Regia Pirocorvetta Italiana 'Magenta,' negli anni 1865–1868." The descriptive and scientific account of this expedition, by Prof. Enrico Hillyer Giglioli, appeared in 1875 (4to. Milan). The Mollusca obtained on the voyage were dealt with by Dr. C. Tapparone-Canefri, in a paper published in the Memoria della Reale Accademia delle Scienze di Torino, ser. II. tome xxviii. 1876 (and also separately). There are about 160 pp. and four quarto coloured plates. It describes Land, Fresh-water, and Marine Mollusca, and includes Brachiopoda.

2. The "Viaggio di Circumnavigazione della R. Corvetta 'Caracciolo' negli anni 1881–84." Commandante C. de Amezaga. (8vo. Roma, 1885–86.)

The Norwegian North Atlantic Expedition (1876–78) did excellent work with the dredge in many departments of zoology.

The "Mollusca," by H. Friele, appeared (1882–86) with 80 pp. and 12 plates folio. It deals chiefly with the Buccinidæ, and gives figures of a large number of radulæ. The text is printed both in English and Norwegian.

The "Investigator," carrying on the deep-sea exploration of the Indian Ocean, under the auspices of the Indian Government, and in connection with the Calcutta Museum, has been engaged in this work since 1879. The results have been published from time to time in the Annals and Magazine of Natural History, and one or two papers have appeared in the Journal of the Asiatic Society of Bengal.

The results of the French scientific expedition of the "Travailleur" and the "Talisman" during the years 1880–83 are now in the course of publication with many beautiful plates. The part on the Brachiopoda by Dr. Paul Fischer and D. P. Œhlert was issued at Paris in 1891.

Dr. C. Semper has published, in a series of five quarto volumes, his "Reisen im Archipel der Philippinen" (1870–1894), the results of his voyage in the Philippine Archipelago. Three large volumes are

devoted to the Mollusca, with many coloured plates, and comprise the Chitons, the Nudibranchs, and the Land Mollusca of the expedition.

The Narrative of the "Three Cruises of the 'Blake'" (1877–1881), as recorded by Alexander Agassiz, occupies 556 octavo pages, published in two volumes, and forms one of the most interesting and best illustrated works on deep-sea exploration that we have seen. Its geographical area includes the whole Atlantic coast of America; the shores of the Gulf of Mexico, the West Indian Islands, and so much of the Atlantic itself as bears upon the ocean currents and especially the great area of the Gulf Stream. To whatever group we turn, whether to the Fish, the Mollusca, Echinoderms, or Crustacea, we find new and interesting material to attract our attention, which even the great series of volumes of the "Challenger" Reports do not surpass in interest, perhaps because of their very greatness.

Pleurotomaria was one of the most remarkable genera dredged by the "Blake." Four recent species (and 14 individuals) of the genus are known. The history of the genus dates back to the Silurian age. To the dredging of the "Hassler" and the "Blake" are due the only knowledge yet acquired of its soft parts. Two species are found in the West Indies, of which the finest is *P. Adansoniana*, from 200 fathoms. The shell is four inches in diameter, richly pearly within, and ornamented with elegant red and brown colours externally. The anal notch extends nearly half the length of the body-whorl. A second species, less brilliant and with a shorter notch, is *P. Quoyana*, also obtained by the "Blake."

In 1865 I figured and noticed the discovery of a specimen of *Pleurotomaria Beyrichii* (Hilgendorf), from Enoshima, Japan (Geol. Mag. 1885, pp. 433–39, pl. xi. fig. 1). A much larger *Pleurotomaria* shell, indeed the second largest of living specimens,[1] was brought from Tobago, in the West Indies, in 1891, by my friend Mr. R. J. Lechmere Guppy, of Port-of-Spain, Trinidad, and referred to *Pleurotomaria Adansoniana* (Proc. Zool. Soc. 1891, Nov. 3, pp. 484–85), alt. 150, diam. 160, length of fissure 220 mm. Although no fewer than 1160 species have been described, four only out of this number survive at the present day, as widely separated geographically as the East and West Indies and Japan.

"Old-fashioned animals," writes Alexander Agassiz, "like *Trigonia*, *Limulus*, and *Lingula*, are all from *shallow water*" (*op. cit.* vol. i. p. 156). Further on he adds: "That none of the palæozoic forms are found in the deep sea, seems to indicate, as has been suggested by Moseley, that its first inhabitants date back no further than the *Cretaceous period*." This appears to me to be a powerful argument against the absolute permanence of ocean-basins; for if the deep-sea forms met with, and which must be the most ancient survivors, have only a Cretaceous facies, then it is fair to infer that the deep-sea areas of pre-Cretaceous times must have been elevated subsequently, and their faunas destroyed. "Of course," he adds,

[1] The largest is *P. Rumphii*, said to be 170 mm. high, by 190 mm. in diameter.

"there must have been pelagic animals, and Foraminifera may have lived at great depths in the track of the currents, but probably no (deep-sea) invertebrates of a period older than the Jura or Chalk existed, or, if they did exist, they did not wander far from the Continental shelf. Their distribution was then, as to-day, mainly a question of food. The animals of those times lived upon the coast shelf, and while they and their predecessors remained as fossils in the littoral beds of the earlier formations, their successors, belonging either to the same or to allied genera, passed over into the following period. The littoral belt is perhaps the most important portion of the sea-floor, since within its limits the greatest changes of light, heat, and motion occur" (p. 157);—and here too, I would add, the greatest influences productive of change in species would naturally be encountered by the denizens of the sea; whilst those in the deeper portions of the ocean, if deprived of many of the advantages enjoyed by the dwellers along the shore, nevertheless pass a safe, calm, and uneventful existence, with which the elements of time and change have but little to do, and they might—assuming the stability of such areas to have remained unchanged, which may well be doubted—have preserved in their dim recesses representatives of palæozoic times living there down to the present day.

The production, by Prince Albert I. of Monaco, of the scientific results accomplished on his yacht "Hirondelle," in 1887, published as six fasciculi in quarto form, 1889–94, under the direction of the Baron de Guerne, is an important addition to our knowledge of marine life. Fasciculo i. is a contribution to the Molluscan Fauna of the Azores, by Philippe Dautzenberg. Of 84 species of Gastropoda 24 are entirely new, never having been previously noticed from the Azores; 16 Pelecypoda are also recorded. Four plates are given, three being coloured. Fasc. ii. is devoted to Sponges (with eleven plates); Fasc. iii. to the Brachiopoda (with two plates); Fasc. iv. to the Opisthobranchia (with four plates); Fasc. v. to *Bathyphysa Grimaldii* (with one plate); and Fasc. vi. to the Holothuria (with two plates).

The results of the "Plankton Expedition," by the German Doctor, Otto Krümmel, 1892, are being published in a style fully equal to that of the "Hirondelle."

An important subject, bearing upon both the past and present Life-history of our planet, to which the Mollusca have contributed a very large share of facts—perhaps more than any other group—is that of the *Geographical Distribution of Animals*.

We know that at the present day the earth's surface may be divided into a series of Zoological Regions, each having its own distinctive fauna, as the Palæarctic, the Ethiopian, the Indian, the Australasian, the Nearctic, and the Neotropical.

The sea, too, has its marine provinces, as — 1. the Arctic; 2. the Boreal; 3. the Celtic; 4. Lusitanian; 5. Aralo-Caspian; 6. W. African; 7. S. African; 8. Indo-Pacific; 9. Australasian; 10. Japonic; 11. Aleutian; 12. Californian; 13. Panamic; 14. Peruvian; 15. Antarctic; 16. Patagonian; 17. Caribbean; 18. Trans-Atlantic.

But when we go back into past geological times we are confronted with another problem, which at first sight seems as difficult to solve as was the Gordian knot to untie, namely: were the great formations (remains of which we find distributed over the whole globe) once continuous and more or less *contemporaneous*, or are we to consider them only as *homotaxial*? The late Edward Forbes was the first who suggested the latter view—in other words, that when we find a bed of rock containing the same group of fossils in widely separated geographical areas, we are not to consider that it is all contemporaneous, but only representative or *homotaxial*, and that long periods of time may really have separated them from one another.

There is, at the present day, a growing conviction amongst Naturalists that, as we know from the records of the earlier life-history of our earth, there were far fewer classes and orders represented in the older rocks, so also that the several geographical provinces had not yet been evolved, and that there was only one marine province over all the oceans of the globe. That with the gradual evolution of varied climate, and changed surroundings, the marine, littoral, and terrestrial faunas and floras became more and more differentiated, until they reached the condition of specialization in which we see them to-day.

We can understand that if this uniformity of condition were connected with a uniformity in temperature, extending over the greater part of our earth, which may well have been the case in the earlier periods of the past, the wideness of distribution which the faunas and floras of the globe then enjoyed, when compared with the limited areas occupied by existing ones, would be readily explained.

The question naturally arises—Are we to consider that all representative species occurring to-day in widely-separated areas have been derived from a common ancestor? I think, as a rule, we are bound to do so, unless the representation be merely *mimetic* and not actual; and I believe this applies not only to differences of latitude and longitude, but also to differences of time; and that the further back a genus dates in geological time, the wider proportionately will be the extent of the geographical area occupied by its surviving representatives.

Turning now to the appearance in time of the two great groups, the Lamellibranchiata and the Gastropoda, we find that to the former, or, as they are now called, Pelecypoda (a much less appropriate designation), more than a third of the known fossil shells belong. They have been estimated at 6,000, and they probably greatly exceed that number. The Asiphonate forms with an open mantle appear to be the more ancient type, those with respiratory siphons and closed mantle-lobes being more characteristic of the Secondary and Tertiary periods. As far as their distribution in time is concerned the former are certainly a most ancient group, several genera being represented in Lower and Upper Cambrian times—yet they attain their maximum to-day.

Amongst the chief Palæozoic forms may be mentioned *Nucula*, *Arca*, and *Avicula*; the Mytilidæ are also largely represented. The

Monomyarian type does not appear till the Upper Palæozoic formations are reached; forms, like *Aviculopecten*, allied to the recent Pectens, carrying this type back to the Carboniferous. Four genera of Lamellibranchs, namely, *Pterinea*. *Conocardium*, *Megalodon*, and *Cardiomorpha*, appear and disappear in Palæozoic times from Silurian to Carboniferous; whilst *Edmondia*, *Myalina*, *Posidonomya*, and *Pleurophorus* appear in Palæozoic times and extend up to the Trias.

One genus, *Isoarca*, appears in the Lower Silurian, and survives to the Chalk. The genus *Gervillia* appears in Carboniferous times, and also survives to the Chalk.

In the Trias many old types disappear, being replaced by more modern forms. Monomyarian bivalves are numerous, whilst the Dimyaria without siphons are still abundant. Gradually, however, the forms with long retractile siphons increase, and replace the older types as we approach the newer rocks.

Opis appears in the Trias, and ends in the Chalk; whilst *Myoconcha* appears in the Permian, and survives to Miocene times.

Three genera, *Gryphæa*, *Inoceramus*, and *Goniomya*, extend from the Lias to the Chalk.

Taneredia and *Unicardium* occur only from the Lias to the Oolite; whilst *Exogyra* appears in the Lower Oolite, and ends in the Chalk.

The Veneridæ appear first in the Jurassic rocks; they increase in the Tertiaries, and culminate in our existing seas.

One family, the Hippuritidæ, including the genera *Caprotina*, *Caprina*, *Caprinella*, *Biradiolites*, *Barrettia*, *Radiolites*, *Hippurites*, numbering nearly 100 species, are confined to the Cretaceous beds, none being found earlier or later, unless they should be included with the Chamidæ, which also appear in the Lower Cretaceous, but extend onwards to the recent period, and are living in the seas of to-day.

Of genera which have survived from very early times, *Arca* is a truly remarkable example, being found in the Lower Silurian and surviving at the present day, the living forms having a world-wide distribution. The genus *Pinna* appears in the Devonian, and survives at the present day; whilst *Lima* dates from the Carboniferous, having 200 fossil and 46 living representatives. *Cyprina* appears in the Muschelkalk, and survives to-day: it is represented by 90 fossil species and 1 living form, *C. islandica*. Four genera, namely, *Trigonia*, *Isocardia*, *Plicatula*, and *Cardita*, appear in the Trias, and have survived to the present day. *Trigonia* has more than 100 fossil species and 6 recent; *Isocardia* has 70 fossil and 5 living species; *Plicatula* has 40 fossil and 24 living species; *Cardita* has 100 fossil and 72 living species.

Three genera, *Astarte*, *Pholadomya*, and *Corbis*, appear first in the Lias, and have survived until to-day. *Astarte* has 200 fossil and 34 living species; *Pholadomya*, 150 fossil and 2 living species; *Corbis*, 80 fossil forms and 5 living species. Two genera, *Limopsis* and *Nœra*, appear in the Oolite, and still survive. Two others, *Unio* and *Cyræna*, begin in Wealden times, and still live on.[1] *Pectunculus*,

[1] All these forms, save *Unio* and *Cyræna*, appear to be marine in habit.

Thetis, and *Crassatella* range from the Neocomian beds to the seas of to-day; *Crenella* and *Chama* from the Upper Greensand to Recent; *Cardium* from Eocene, and *Tridacna* from Miocene to Recent times.

Taking next the Gastropoda, we find that the Prosobranchiata, possessing as they do a calcareous shell and being of aquatic habits, are largely represented in a fossil state; though the section Heteropoda are only represented in Tertiary deposits.

The Opisthobranchiata are only imperfectly represented in past times; the section Nudibranchiata is, of course, quite unknown in a fossil state. On the other hand of the section Tectibranchiata, Pteropods, belonging to the genus *Hyolithes*, are met with in considerable numbers in the Lower Cambrian rocks, but are absent from the Neozoic formations. This is a strong argument in favour of the later deposits having been largely formed near shore, or in inland seas, whilst the earlier deposits were laid down in wider oceanic areas.

Those Pulmonate Gastropoda which live habitually in fresh water (as the Limneidæ), are better represented in the Secondary rocks than are their purely terrestrial relatives (the Helicidæ), but even these last are occasionally met with, and two genera have actually been found as far back as in the Coal-measures of N. America.

The Prosobranchiate Gastropoda appear in the Cambrian, from which quite a number of forms have been obtained; of these the genera *Murchisonia* and *Pleurotomaria* are amongst the most important.

Numerous (holostomatous) Gastropods are found in the Ordovician and Silurian rocks. *Euomphalus*, *Pleurotomaria*, and *Bellerophon* are the most prominent types.

The Pteropods are represented by *Conularia*, *Hyolithes*, and *Tentaculites*.

In later Palæozoic times (Devonian, Carboniferous, and Permian) the general character of the Mollusca remains unchanged, the predominating forms still being holostomatous Prosobranchs and Pteropods.

In the Coal-measures we meet with the earliest known forms of Pulmonata, true land-dwelling, air-breathing Snails, *Zonites* and *Pupa*; discovered by Sir William Dawson in the hollow, but still erect, sigillaria-trees of the South Joggins Coal-field, Nova Scotia.

In the Triassic period, the main characteristics of the Gastropods are those of the earlier Palæozoic period; but siphonostomatous Prosobranchs, such as *Cerithium*, *Purpurina*, etc., have already made their appearance, and the old forms of Pteropods (save *Conularia*) have disappeared, and modern forms, like *Styliola*, have come in.

In the Jurassic rocks siphonostomatous Snails prevail, and the first Opisthobranchs appear; whilst fresh-water genera, like *Planorbis*, *Paludina*, *Melania*, etc., are met with.

In the Cretaceous period forms belonging to existing genera continue to increase in number, and in the Tertiaries they become predominant, the representatives of extinct genera being rare.

The Patellidæ (Limpets) appear as early as the Cambrian rocks (*e.g. Tryblidium*). The various forms of Limpet-shaped shells, with a recurved apex and spiral nucleus, with the anterior margin notched,

or the apex perforated (Fissurellidæ), are probably of equal antiquity with *Patella*.

The Pleurotomariidæ, represented to-day by *Pleurotomaria* and *Scissurella*, present a group of the highest interest to the Malacologist, as affording a most striking example of the persistence of a very ancient form down to the present time. The members of this peculiar family of shells are all marked by having the outer lip perforated or slit, more or less deeply. Of the genus *Pleurotomaria* four species only are known to survive at the present day (namely, *P. Rumphii*, *P. Beyrichii*, *P. Quoyana*, and *P. Adansoniana*), but there are at least 1160 species known occurring fossil from the Lower Cambrian to the newest Tertiary species. Closely related to *Pleurotomaria* are such forms as *Scalites*, *Rhaphistoma*, *Helicotoma*, *Brilonella*, *Luciella*, *Catantostoma*, and *Polytremaria*, all palæozoic genera, provided with slits or perforations. To these we may add *Murchisonia*, a turrited shell, but having the slit-band around the whorls and the fissured lip. Of this genus there are upwards of 50 fossil species, ranging from the Lower Silurian to the Permian.

Trochotoma has 30 species fossil, ranging from the Lias to the Coral Rag. Its lip has a single perforation near the margin. *Leveillia* is sometimes classed with the Bellerophontidæ, but is really referable to the Pleurotomariidæ. The shell is discoidal, many-whorled; outer lip having a deep slit, and the whorls having a well-marked band running along the centre of the dorsal line.

Placed next to the Pleurotomariidæ are the Bellerophontidæ, with *Bellerophon* and *Trematonotus*, etc. In *Bellerophon* the aperture is expanded, sinuated, and deeply notched on the dorsal line. There are 70 species fossil, ranging from Lower Silurian to Carboniferous. *Trematonotus* is not unlike *Bellerophon* in form, but instead of a simple notch it has a series of perforations which are successively obliterated. Several species have been described from the Silurian and Devonian of North America, Sweden, England, and Bohemia.[1]

Near to *Pleurotomaria* there is another genus, which like it is also a nacreous shell, but with perforations, not a long slit, viz., *Haliotis*. About 75 species are recorded living; they are very widely distributed. Four species occur fossil from the Maestricht Chalk and the Miocene of Malta.

The same difficulty prevails with regard to the Mollusca that has been met with in other groups, namely, to trace back their origin to a Primitive Form.

As regards the Gastropoda, we meet with small Limpet-like shells in the earliest rocks (Lower Cambrian)—*Stenotheca*, *Tryblidium*, and *Scenella*, and also others with a spiral nucleus, as *Platyceras* (*Capulus*), *Pileopsis*, and even small species of *Pleurotomaria*. With these are associated Pteropod shells referred to *Hyolithes* and *Salterella*, etc. It is not, however, clear whether any one of these can be considered as representing the primitive Gastropod.

With reference to the Lamellibranchiata, such early genera as

[1] See Geol. Mag. 1885, p. 39, and 1890, pp. 337 and 525.

Fordilla, *Nucula*, *Modioloides*, *Modiolopsis*, *Pterinea*, *Posidonomya*, *Arca*, *Isoarca*, *Conocardium*, *Megalodon*, *Cardiomorpha*, and others offer so much variety of form as to lead one to conclude that we are still very far from having arrived at a primordial bivalve.

Amongst the Scaphopoda, the genus *Dentalium* occurs fossil in the Lower Silurian, and has survived to the present day. About 160 fossil forms and nearly 100 living species, very widely distributed, are known.

Lastly, of the order Polyplacophora, Chitons have been recorded fossil as far back in time as the Lower Silurian, and are abundantly represented in the seas of to-day.

I have avoided speaking of the Cephalopoda, as I felt that to deal with that group alone would more than suffice for an entire address. They have, moreover, quite lately formed the subject of an Address by Prof. Blake to the Geologists' Association. I will merely state that in the opinion of the late Dr. J. Barrande the Cephalopods of the earlier rocks offer no sign of evolution, but only of most remarkable persistence in those types which, like *Nautilus*, have survived; whilst *Goniatites* and *Ammonites* appear suddenly, and retain their distinctive characters until their final extinction. Probably later on Mr. Crick will give us his views on the Cephalopoda in relation to their evolution in geological time.

Since the publication of Darwin's "Origin of Species," in 1859, far more attention has been paid by biologists to questions relating to variation and evolution and the development of living things than had seemed needful to the older naturalists, our immediate predecessors, who had inherited a firm belief in the immutability of species. Thus, the late Edward Forbes writes ("Nat. Hist. of British Seas," p. 8): "Every true species presents in its individuals certain features, *specific characters*, which distinguish it from every other species; as if the Creator had set an exclusive mark or seal on each type" Indeed, it seems to me that the earlier naturalists looked specially for resemblances, whilst later observers have paid more attention to differences, often even to extremely minute variations. Linnæus expresses his opinion respecting genera and species thus: "*Classis et ordo est sapientiæ, species naturæ opus*," which may be freely translated "*Species are real; genera ideal.*" "The marshalling of species in classes and orders is matter of discretion; but species themselves are the work of God." (S. P. Woodward.)

Firmly believing as I do in Evolution, I cannot but feel that we seem still to need much more extensive and intimate knowledge of the races of living beings which preceded the present Molluscan fauna, in order to demonstrate clearly their origin and descent. We know that the present races closely resemble their immediate predecessors, and differ more and more from the shells of older geological times. We must, of course, admit the validity of the plea of the imperfection of the Geological Record, yet at the same time (allowing for that imperfection) we cannot fail to discern a steady onward progress in most organisations, marked, however, by some curious exceptions:—

1. One fact is apparent from our Geological Record of the past,

namely: that a great many forms probably became extinct, because they could not change and adapt themselves to new external conditions.

2. Another series have from early times selected for themselves special habitats so peculiar and unlike those of the rest of their class, that they have as a consequence become in a sense retrogaded and deteriorated by their surroundings so as to lose caste, as it were, in the Molluscan sub-kingdom (*e.g.* parasitic, sedentary, and boring forms, and some of the burrowing and coral-dwelling forms).

3. On the other hand, we also see that a considerable number of the Palæozoic and Mesozoic types have survived to our own day, and, although they may have become extinct in the regions where they once were abundant, they still linger on, in diminished numbers, in out-of-the-way localities, where the hostile influences have proved to be less severe.[1]

I must now conclude these scattered notes, which, from their mixed and fragmentary character, may be compared to a haul of the naturalist's dredge, and like it, too, may perhaps serve to convey to you, in some slight degree, the wealth of material that lies below, and which only requires to be brought to the surface out of the vast, but little explored, literary sea. In both these directions it will be your duty, as I am sure it will also prove your pleasure, as members of this Society, to extend your explorations, and to record in our "Proceedings" your observations in the near future *per mare et terris*.

* * * * *

"For the sea, too, seeks and rejoices,
Gains, and loses, and gains,
And the joy of her heart's own choice is
As our's, and as our's are her pains."

(Sea and Shore.)

[1] For example, *Chrysodomus contrarius*, so abundant a fossil in the Red Crag, is still found living in Vigo Bay, off the coast of Spain.